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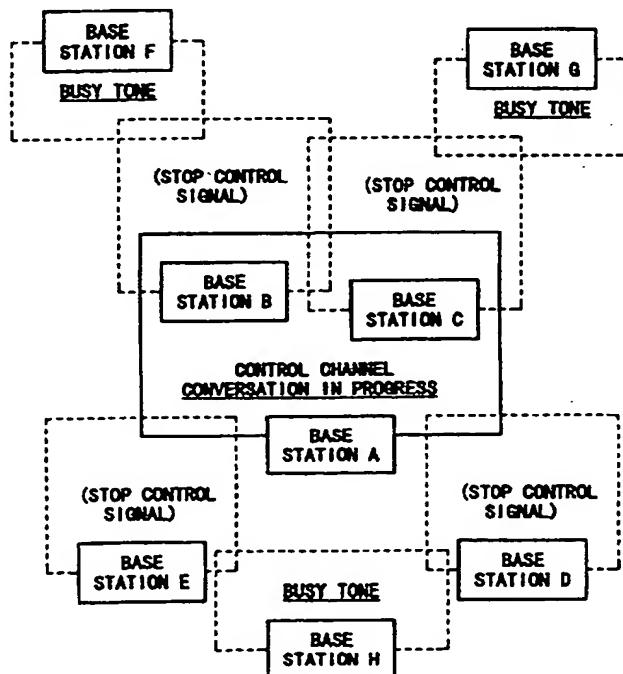
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(54) Abstract Title

Channel allocation method

(57) A channel allocation method is provided for a communication system, the method comprises the steps of detecting congestion of communication channels at a base station and allocating a control channel as a new communication channel when a conversation request is given from a mobile station. When conversation is terminated on the new conversation channel or a vacant conversation channel is detected at the base station, the new conversation channel is restored to its control function. In order to avoid jamming when the control channel is allocated as a conversation channel, the base station transmits a low frequency tone to other mobile stations to inform of utilization of the control channel for conversation, while adjacent base stations stop transmitting control signals.

FIG.2



GB 2 328 586 A

FIG.1A

CHANNEL 1	CONTROL IN PROGRESS
CHANNEL 2	VACANT
CHANNEL 3	VACANT
CHANNEL 4	VACANT

FIG.1B

CHANNEL 1	CONTROL IN PROGRESS
CHANNEL 2	CONVERSATION IN PROGRESS
CHANNEL 3	CONVERSATION IN PROGRESS
CHANNEL 4	CONVERSATION IN PROGRESS

FIG.1C

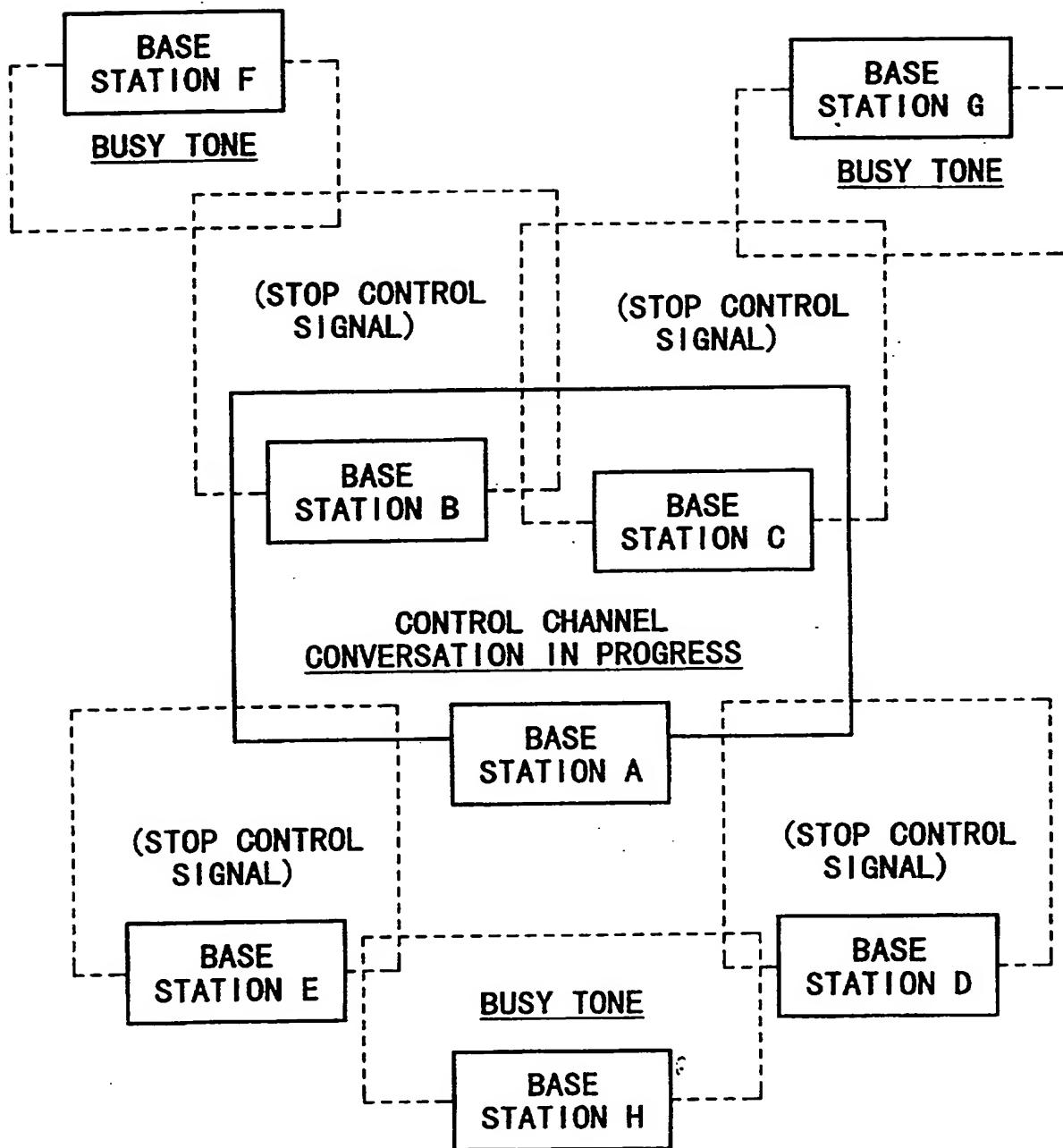
CHANNEL 1	CONVERSATION 4 IN PROGRESS
CHANNEL 2	CONVERSATION 1 IN PROGRESS
CHANNEL 3	CONVERSATION 2 IN PROGRESS
CHANNEL 4	CONVERSATION 3 IN PROGRESS

FIG.1D

CHANNEL 1	CONTROL IN PROGRESS
CHANNEL 2	CONVERSATION 1 IN PROGRESS
CHANNEL 3	CONVERSATION 4 IN PROGRESS
CHANNEL 4	CONVERSATION 3 IN PROGRESS

TRANSFER CONVERSATION 4 FROM
CHANNEL 1 TO CHANNEL 3

FIG.2



CHANNEL ALLOCATION METHOD

BACKGROUND OF THE INVENTION

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Field of the Invention

This invention relates to conversation channel allocation methods applicable to mobile communication systems based on the MCA method using control channels. This application is based on patent application No. 10 11 Hei 9-188722 filed in Japan, the content of which is incorporated herein by reference.

Description of the Related Art

It is well known in the mobile communication systems of the MCA method that control channels are fixedly used for transmission of control signals while conversation channels are fixedly used for conversation. 15 Each mobile station performs radio communication using any one of the control channels with respect to a base station, so that a calling party is capable of performing conversation with a called party. Herein, the conversation channel is selected from among prescribed conversation 20 channels, which are prepared in advance. So, the selected conversation channel is allocated to each mobile station.

As described above, the conventional mobile communication systems are designed in such a manner that the conversation channels are fixed. So, if a number of the used conversation channels reaches a maximum 25 number of channels in response to an increase of traffic, a congested state

occurs, which causes a problem that a new mobile station cannot start conversation any more.

SUMMARY OF THE INVENTION

5 It is an object of at least the preferred embodiment of the invention to provide a conversation channel allocation method that enables a new mobile station to start conversation even if all of conversation channels are used for conversations in a mobile communication system.

10 There is provided a conversation channel allocation method of a mobile communication system of MCA method that performs allocation of conversation channels between base stations and mobile stations. At a congestion state where all of the conversation channels are used for conversations respectively, when a new conversation request is given from a mobile station, a control channel, which is originally used for transmission 15 of a control signal, is allocated to such a mobile station as a new conversation channel. Thus, the mobile station is capable of performing radio communication with the base station by using the control channel, so that a calling party is capable of performing conversation with a called party without interruption.

20 When the conversation is completed, the control channel is restored by canceling its function as the new conversation channel. If any one of the conversation channels ends conversation prior to completion of the conversation using the control channel so that it is now placed as a vacant conversation channel, the control channel is restored by canceling its 25 function as the new conversation channel while such a vacant conversation

channel is used for the conversation of the mobile station.

5 In order to avoid jamming, the base station transmits a signal of low frequency tone, which is out of a prescribed conversation band, to other mobile stations to inform of utilization of the control channel for the conversation of the mobile station, so that the other mobile stations perform a display of "conversation in progress", for example. In addition, adjacent base stations stop transmitting control signals, so that their mobile stations perform a display of "out of 10 communication service range", for example.

15 Accordingly, in a first aspect, the invention provides a channel allocation method in a mobile communication system in which a base station is capable of sending a control signal to a mobile station using a control channel, and in which the mobile station is capable of performing radio communication with the base station using a conversation channel so that communication is established between a calling party and a called party, said channel allocation method comprising the steps of:

20 detecting congestion of conversation channels at the base station; and when the conversation channels are detected to be congested, allocating a control channel as a new conversation channel for the mobile station.

In a second aspect, the invention provides a channel allocation method of a mobile communication system in which a mobile station performs radio communication with a base station, said channel allocation method comprising the steps of:

25 detecting a congestion state in which all conversation channels are used for conversations respectively;

allocating a control channel to the mobile station as a new conversation channel in response to a new conversation request given from the mobile station at the congestion state; and

30 restoring the control channel to its control function and terminating as a conversation channel when conversation using the control channel is ended.

In a third aspect, the invention provides a base station of a mobile communication system comprising:

5 means for sending control signals to a mobile station using a control channel;

means for performing radio communication with the mobile station using a conversation channel for establishing communication between a calling party and a called party;

10 means for detecting congestion of conversation channels at the base station; and

means for allocating a control channel as a new conversation channel for the mobile station when the conversation channels are detected to be congested.

In a fourth aspect, the invention provides a base station of a mobile communication system comprising:

means for performing radio communication with a mobile station;

means for detecting a congestion state in which all conversation channels are in use for conversations;

20 means for allocating a control channel to the mobile station as a new conversation channel in response to a new conversation request given from the mobile station during the congestion state; and

means for restoring the control channel to its control function and terminating its function as a conversation channel when conversation using the control channel is ended.

25 In a fifth aspect, the invention provides a mobile communication system as set out in claim 13.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred features of the present invention will now be described, purely by 30 way of example only, with reference to the accompanying drawings, in which:-

FIG. 1A, FIG. 1B, FIG. 1C and FIG. 1D show channel utilization states, which are used to explain a preferred embodiment of a conversation channel allocation method of a mobile communication system in accordance with the invention; and

5 FIG. 2 is a system diagram showing the mobile communication system using base stations, which provide measures to avoid jamming due to utilization of a control channel for conversation in accordance with the invention.

FIG. 1A, FIG. 1B, FIG. 1C and FIG. 1D show channel utilization states in a mobile communication system to which a preferred embodiment of the conversation channel allocation method is applicable. For convenience' sake, the above drawings are provided with regard to an 5 example that the mobile communication system uses four channels, which are designated by "channel 1", "channel 2", "channel 3" and "channel 4" respectively. However, this invention is applicable to other examples of mobile communication systems that use a higher number of channels.

In a state of FIG. 1A, the channel 1 is used as a control channel to 10 send a control signal, while the channels 2 to 4 can be used as conversation channels, none of which is used now.

In a state of FIG. 1B, the channel 2 is allocated to conversation 1; the channel 3 is allocated to conversation 2; and the channel 4 is allocated to conversation 3.

15 When a new conversation request (i.e., call request) is made in the state of FIG. 1B, the channel 1 originally used as the control channel is allocated to conversation 4 corresponding to the new conversation request, which is shown in FIG. 1C.

When the conversation 4 is completed, the channel 1 switches over 20 function thereof from the conversation channel to the control channel, so that the state of FIG. 1C is returned to the state of FIG. 1B.

However, if any one of the conversations 1 to 3 ends prior to completion of the conversation 4, the conversation 4 then proceeds using the vacant conversation channel so that the channel 1 25 switches over function thereof from the conversation channel to the control channel, which is shown in FIG. 1D.

As described above, the present embodiment is designed such that in the case of the shortage of the conversation channels, the control channel is used as the conversation channel. In the case where such a change is made, however, it is necessary to provide some measures to avoid jamming 5 that takes place between the conversation of the control channel and registered control signal from the mobile station.

Next, a description will be given with respect to the measures to avoid jamming in the present embodiment with reference to FIG. 2.

Suppose an example that a base station A performs conversation 10 using a control channel with a mobile station. In such an example, the base station A transmits a signal using a low frequency tone, which is out of the prescribed conversation band, with respect to other mobile stations, which are placed under control of the base station A. Thus, the base station A communicates with the other mobile stations to inform of 15 utilization of the control channel. In addition, the base station A controls the mobile stations to perform a display of "conversation in progress", for example. Adjacent base stations (i.e., base stations B, C, D and E) do not perform sending of control signals. Thus, mobile stations, which are placed under control of the adjacent base stations, perform a display of "out 20 of communication service range", for example. In addition, further adjacent base stations (i.e., base stations F, G and H), which are located further adjacent to the adjacent base stations, perform sending of busy tone using the control channel. The further adjacent base stations inform mobile stations thereof of progression of conversation that other base 25 stations perform using the control channel. So, the mobile stations

perform a display of "conversation in progress".

5 By the above controlling of the mobile stations under the base stations, it is possible to avoid occurrence of jamming.

According to the present embodiment of the invention, the control channel is used as the conversation channel in the case where shortage of conversation channels occurs, so there is provided a remarkable effect that congestion of lines can be automatically released.

10 As this invention may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive.

15 Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features.

Statements in this specification of the "objects of the invention" relate to preferred embodiments of the invention, but not necessarily to all embodiments of the invention falling within the claims.

20 The description of the invention with reference to the drawings is by way of example only.

25 While the present invention has been described in its preferred embodiments, it is to be understood that the words which have been used are words of description rather than limitation and that changes may be made to the invention without departing from its scope as defined by the appended claims.

The text of the abstract filed herewith is repeated here as part of the specification.

A conversation channel allocation method is provided for a mobile communication system of MCA method to perform allocation of conversation channels between base stations and mobile stations. At a congestion state 5 where all of the conversation channels are used for conversations respectively, when a new conversation request is given from a mobile station, a control channel, which is originally used for transmission of a control signal, is allocated to such a mobile station as a new conversation channel. Thus, the mobile station is capable of performing radio 10 communication with the base station by using the control channel, so that a calling party is capable of performing conversation with a called party without interruption. When the conversation completes, the control channel is restored by canceling its function as the new conversation channel. If any one of the conversation channels ends conversation prior to 15 completion of the conversation using the control channel so that it is now placed as a vacant conversation channel, the control channel is restored by canceling its function as the new conversation channel while such a vacant conversation channel is used for the conversation of the mobile station. Incidentally, in order to avoid jamming, the base station transmits a signal 20 of low frequency tone, which is out of a prescribed conversation band, to other mobile stations to inform of utilization of the control channel for the conversation of the mobile station, while adjacent base stations stop transmitting control signals.

CLAIMS:

5 1. A channel allocation method in a mobile communication system in which a base station is capable of sending a control signal to a mobile station using a control channel, and in which the mobile station is capable of performing radio communication with the base station using a conversation channel so that communication is established between a calling party and a called party, said 10 channel allocation method comprising the steps of:
 detecting congestion of conversation channels at the base station; and
 when the conversation channels are detected to be congested, allocating a control channel as a new conversation channel for the mobile station.

15 2. A channel allocation method as defined in claim 1 further comprising the steps of:
 detecting a conversation channel which becomes vacant whilst the control channel is allocated to the mobile station as a new conversation channel; and
 restoring the control channel to its control function and terminating as a 20 conversation channel, and allocating the vacant conversation channel to the mobile station.

25 3. A channel allocation method of the mobile communication system as defined in claim 1 or 2 wherein, whilst the control channel is allocated to the mobile station as a new conversation channel, the base station transmits a tone whose frequency range is outside a prescribed conversation band while an adjacent base station adjacent to the base station stops using the control channel, and wherein a further adjacent base station further adjacent to the adjacent base station transmits a busy tone.

30 4. A channel allocation method of a mobile communication system in which a

mobile station performs radio communication with a base station, said channel allocation method comprising the steps of:

5 detecting a congestion state in which all conversation channels are used for conversations respectively;

 allocating a control channel to the mobile station as a new conversation channel in response to a new conversation request given from the mobile station at the congestion state; and

10 restoring the control channel to its control function and terminating as a conversation channel when conversation using the control channel is ended.

5. A channel allocation method as defined in claim 4 further comprising the steps of:

15 detecting occurrence of a vacant conversation channel within the conversation channels while the control channel is allocated to the mobile station as the new conversation channel; and

 restoring the control channel to its control function and terminating as a conversation channel and allocating the vacant conversation channel to the mobile

20 station.

6. A channel allocation method as defined in claim 4 or claim 5 further comprising the steps of:

25 transmitting a signal tone of low frequency, which is outside a prescribed conversation band, to another mobile station to inform of utilization of the control channel for the conversation of the mobile station; and

 controlling an adjacent base station, adjacent to the base station that communicates with the mobile station using the control channel, to stop transmitting a control signal,

30 whereby occurrence of jamming is avoided.

7. A base station of a mobile communication system comprising
means for sending control signals to a mobile station using a control
5 channel;

means for performing radio communication with the mobile station using a
conversation channel for establishing communication between a calling party and
a called party;

means for detecting congestion of conversation channels at the base
10 station; and

means for allocating a control channel as a new conversation channel for
the mobile station when the conversation channels are detected to be congested.

8. A base station according to Claim 7, further comprising

15 means for detecting a conversation channel which becomes vacant whilst
the control channel is allocated to the mobile station as a new conversation
channel; and

means for restoring the control channel to its control function and
terminating its function as a conversation channel, and allocating the vacant
20 conversation channel to the mobile station.

9. A base station according to Claim 7 or Claim 8, further comprising

means for transmitting a tone whose frequency range is outside a
prescribed conversation band whilst the control channel is allocated to the mobile
25 station as a new conversation channel;

means for causing an adjacent base station adjacent to the base station to
stop using the control channel; and

means for causing a further adjacent base station further adjacent to the
adjacent base station to transmit a busy tone.

10. A base station of a mobile communication system comprising means for performing radio communication with a mobile station; 5 means for detecting a congestion state in which all conversation channels are in use for conversations; means for allocating a control channel to the mobile station as a new conversation channel in response to a new conversation request given from the mobile station during the congestion state; and 10 means for restoring the control channel to its control function and terminating its function as a conversation channel when conversation using the control channel is ended.
11. A base station according to Claim 10, further comprising 15 means for detecting occurrence of a vacant conversation channel within the conversation channels while the control channel is allocated to the mobile station as a new conversation channel; and means for restoring the control channel to its control function and terminating its function as a conversation channel, and for allocating the vacant 20 conversation channel to the mobile station.
12. A base station according to Claim 10 or Claim 11, further comprising means for transmitting a signal tone of low frequency, which is outside a prescribed conversation band, to another mobile station to inform of utilization of 25 the control channel for conversation; and means for causing an adjacent base station adjacent to the base station that communicates with the mobile station using the control channel, to stop transmitting a control signal, whereby occurrence of jamming is avoided.

13. A mobile communication system including a base station according to any of Claims 7 to 12.

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14. A method, a base station or a mobile communication system, substantially as described hereinabove with reference to Figures 1 and 2 of the accompanying drawings.



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Claims searched: 1-14

Examiner: Robert Macdonald
Date of search: 16 December 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4L(LDSU, LDSY)

Int Cl (Ed.6): H04Q(7/22, 7/36, 7/38))

Other: ONLINE: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 97/16931 A1 (MOTOROLA) Page 5, lines 11 to 17, especially.	1,2,4,5,7, 8,10,11
A	WO 95/19687 A1 (NOKIA) Whole Document	
X	WO 93/10643 A1 (MOTOROLA) Whole document	1,2,4,5,7, 8,10,11
A	WO 93/10600 A1 (MOTOROLA) Whole document	

X Document indicating lack of novelty or inventive step
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